

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

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OFFICE OF THE SECRETARY

In the Matter of)

Inquiry Regarding Software)
Defined Radios)

ET Docket No. 00-47

REPLY COMMENTS OF AT&T WIRELESS SERVICES, INC

AT&T Wireless Services, Inc. ("AT&T") hereby submits its reply comments on the Commission's Notice of Inquiry in the above-captioned proceeding.^{1/} While the Commission correctly concludes that Software Defined Radio ("SDR") technology "could offer tremendous advantages to consumers over currently available wireless equipment,"^{2/} the commenters in this proceeding demonstrate that SDR technologies are still in a nascent stage of development, and full implementation of SDR is many years away. Accordingly, as AT&T explains below, a rulemaking on SDR at this time would be premature, and would pose serious practical and technical risks in the short term, while threatening more widespread adoption in the longer term. Perhaps most importantly, AT&T urges the Commission not to allow technical "fixes" to replace good spectrum management and policy development. SDRs are not a panacea for the problems of spectrum scarcity and frequency sharing that the Commission currently faces.

As an initial matter, it is evident from the comments filed in response to the Notice that SDRs are not developed enough yet for the Commission to propose rule changes that will affect long-standing allocation, assignment, and certification policies. Nor does there appear to be any pressing need for such rule changes at this time. This is especially clear given the fact that the commenting parties have widely disparate views on what SDR is today and what it might become. For example, some commenters refer to SDR as radios that permit operation in a band

^{1/} Inquiry Regarding Software Defined Radios, ET Docket No. 00-47, Notice of Inquiry (rel. March 21, 2000) ("Notice").

^{2/} Id. at ¶ 1.

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using multiple standards.^{3/} This type of equipment is in use now in many services and manufacturers are continuing to refine and expand upon it. Other commenters and the Commission, however, characterize SDRs as the ultra wideband evolution of this currently-available technology, which will incorporate no system-specific components.^{4/}

What almost all the commenters agree on, however, is that SDR technology is still in its nascent stages. Although commenters differ significantly on the timeframe for developing SDRs, it is clear that the full potential of SDR technology will not be realized for many years. BellSouth, for instance, estimates that it will be at least ten years before adaptive intelligent SDR techniques are widely available in both handsets and base stations.^{5/} Similarly, Nokia states that the vision of SDR equipment as analogous to personal computers through which end users can easily change components or software is “unlikely to be reached earlier than 2010.”^{6/} The manufacturers at the forefront of SDR research -- those tasked with developing SDR equipment - explain that this pace of development is not surprising given the myriad of technological hurdles yet to be resolved.^{7/} Indeed, while many products today are software-configured to operate with different system standards, manufacturers are far from the goal of developing completely generic SDR equipment in which all system-specific components have been eliminated.^{8/}

Furthermore, even when the technologies themselves are sufficiently mature, it will still take many years for consumers to accept and operators to deploy them; meaning that realization of the full benefits of SDRs is still much more than a decade away. As Ericsson notes, SDR technology will be deployed gradually over time, but is unlikely to reach commercial

^{3/} See, e.g., AirNet Comments at 3-4 (noting that the SDR “evolution has already started and SDR technology is being deployed today. . . .”); BellSouth Comments at 2; HYPRES, Inc. Comments at 2.

^{4/} See Notice at ¶ 3; Motorola Comments at 3-4; Nokia Comments at 2-3; SDR Forum Comments at 11.

^{5/} BellSouth Comments at 5.

^{6/} Nokia Comments at 2.

^{7/} Ericsson Comments at 2-3; Lucent Comments at 2; Motorola Comments at 16; Nokia Comments at 2-3.

^{8/} See Nokia Comments at 3.

development in the near future.⁹ At this point, it is not at all clear whether there is a supportable business case for the complete interoperability between systems permitted by SDR. Consumers appear to be more interested in smaller handsets and new services than in a development, which, according to Motorola, could carry substantial penalties in terms of cost, size, and power dissipation compared to single-purpose equipment.^{10/} Operators such as AT&T, on the other hand, have invested billions of dollars to build out their networks across the country. This level of investment cannot be changed out easily. The process of deploying SDRs and integrating them into the network is likely to be a multi-year effort and can only commence once the technology has been thoroughly evaluated and the business case proven.

In light of the length of time before SDR becomes commercially viable, an attempt to craft service, technical, and licensing rules at this stage would be sorely misguided. The development of SDR is a continuous process that must take into account ever-changing technological innovations and business realities. It would make no sense to freeze the technology in place by guessing at the direction it will take. Removing the industry's flexibility to create new products and adopt appropriate standards could easily stifle SDR development and innovation.^{11/}

The immaturity of the technology also raises significant concerns about the impacts SDRs might have. Although the ultimate vision of band-hopping SDRs raises exciting prospects for vendors, carriers, and consumers, troubling issues of interference and spectral chaos remain. User groups, for example, express concern that the flexibility to jump from band to band that could be made possible by SDRs also has the potential to cause interference to users who may require the same frequencies for previously designated purposes, including emergency response situations.^{12/} According to APCO, a malfunctioning radio today will usually affect only the user

^{9/} Ericsson Comments at 2.

^{10/} Motorola Comments at 12. See also Nokia Comments at 5.

^{11/} See Lucent Comments at 2. See also Nokia Comments at 2 ("Nokia views the development of SDR technology as a continuous process with the division of hardware and software constantly evolving. For this reason, Nokia believes it is important to not 'freeze' the division between software and hardware prematurely.").

^{12/} APCO Comments at 2-3; API Comments at 6; ITA Comments at 4.

of that radio, while an SDR with a software “glitch” could pose serious interference problems for users in a multitude of frequency bands.^{13/} Moreover, SDRs could increase the potential for tampering and unauthorized use of certain frequencies, such as those used for public safety communications.^{14/} AT&T shares these concerns. As a licensee with both fixed and mobile systems operating in a wide range of frequency bands—from 800 MHz to 39 GHz—the prospect of radios that could use AT&T’s assigned frequencies at any time is daunting indeed.

There is also no evidence that the spectrum sharing concept presented in the Notice -- one of the asserted advantages of SDRs -- is technically feasible, at least in the near term. As APCO states, “it is at best unclear how SDRs will distinguish between currently unused channels, and mere gaps in conversation or data bursts. A great danger is [that] an SDR could unintentionally disrupt a critical and ongoing, but briefly ‘quiet’ public safety emergency communication.”^{15/} BellSouth, likewise, does not believe that major enhancements in adaptive spectrum sharing, flexible spectrum management, or interruptible spectrum usage can be achieved until adaptive intelligent software is available in most handsets and base stations. It asserts that a major obstacle to attaining this goal is that all technologies intending to occupy certain spectrum may have to have been designed with spectrum sharing or flexible usage in mind at the outset.^{16/} It may be very difficult, if not impossible, to retrofit existing systems, which were designed to operate in unshared spectrum, to accommodate the type of spectrum sharing envisioned by the Commission and some commenters. Motorola also notes that the ability to locate free spectrum arbitrarily in real time and utilize it efficiently is an extremely complex and costly endeavor. According to Motorola, “[s]ignificant new development of spectrum allocation algorithms in the network is required for this to become a reality. SDR technology alone is not sufficient.”^{17/} This

^{13/} APCO Comments at 2.

^{14/} Id.

^{15/} Id. at 3.

^{16/} BellSouth Comments at 5-6.

^{17/} Motorola Comments at 28.

is the reason that the full benefits of SDRs will not be seen until significantly after products become commercially available.

Similarly, hopes that SDRs will significantly improve spectrum efficiency also appear to be unrealistic in the short term. The commenters generally agree that SDR technology, in and of itself, is unlikely to have a major effect on spectral efficiency.^{18/} Some parties, such as Motorola and BellSouth, believe that although SDR technology does not implicitly affect efficiency, it has the potential to “facilitate the implementation of multiple standards that adapt the modulation formats to optimize the spectral efficiency for a given set of delivered services.”^{19/} Nokia concurs that spectral efficiency depends largely on characteristics that are determined by system standards and specifications, and states that the development of equipment capable of increasing its efficient use of spectrum by software downloads is not yet foreseeable.^{20/}

The nascent state of SDR development, as well as the unsettled notion of what is being developed, whether it will permit dynamic spectrum sharing, enhance spectrum efficiency, or cause unacceptable interference, lead many parties, including AT&T, to conclude that SDR cannot be a viable substitute for good spectrum management. Indeed, most commenters agree that engaging in ad hoc spectrum allocation or allowing services to be placed adjacent to one another without consideration of interference issues would undermine the public interest and the goal of optimal spectrum use.^{21/}

^{18/} Spectral efficiency is generally defined as “the ability to define a waveform by its tight spectral containment, typically measured in bits per second per hertz (BPS).” SDR Forum Comments at 21. It can also refer to channel or utilization efficiency, *id.*, and the comments are similarly inconclusive about whether SDR technology will have a positive impact on this type of efficiency, especially in the near term.

^{19/} Motorola Comments at 28; BellSouth Comments at 4. For these purposes, Motorola and BellSouth view spectral efficiency as a “bits per second per hertz” issue. *Id.*

^{20/} Nokia Comments at 7.

^{21/} *See, e.g.*, API Comments at 4 (Commission should be careful not to create a “free for all” in spectrum allocation by disregarding current licensing process); Motorola Comments at 27; Nokia Comments at 7-8 (“Leaving spectrum management to the ‘spectrum owner’ may not ensure sufficiently efficient spectrum use without additional regulatory measures.”). In contrast, if bands were properly harmonized, it could expedite the development of SDRs and make them less expensive because fewer bands would need to be incorporated into the system standards.

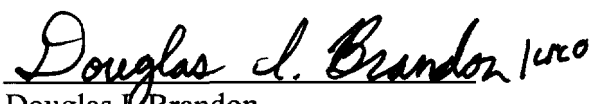
Perhaps, at some point in the distant future, an extremely advanced and universally deployed form of SDR technology will allow users to share a vast sea of essentially unlicensed spectrum. That day is not close, however, and for the time being, the Commission must continue to allocate spectrum, distribute licenses, address interference, and approve equipment. Nor can the Commission view SDR as a solution to existing or near-term spectrum shortages.^{22/} As AT&T has emphasized in other proceedings, cellular and PCS carriers are spectrum constrained today in many markets and are likely to face serious difficulties in rolling out advanced third generation wireless services if more spectrum is not made available.^{23/} Unless and until the many technical and practical issues surrounding SDR development are resolved, SDR cannot be viewed as a means to avoid the thorny allocation problems of today.

CONCLUSION

For the reasons set forth above, AT&T urges the Commission to continue to monitor the progress of SDR development but to refrain from adopting SDR rules at this time.

Respectfully submitted,

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^{22/} See Ericsson Comments at 1, 3; Nokia Comments at 7.

^{23/} See, e.g., Comments of AT&T Wireless Services, Inc., Amendment of the Commission's Rules Regarding Installment Payment Financing for Personal Communication Services (PCS) Licenses, WT Docket 97-87, at 5 (filed June 22, 2000).

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I, Margaret D. Davis, hereby certify that on the 14th day of July 2000, a copy of the Reply Comments of AT&T Wireless Services, Inc., in ET Docket No. 00-47 were served on the following:

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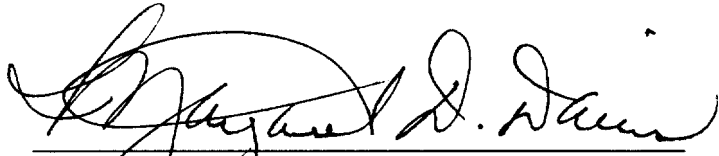
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